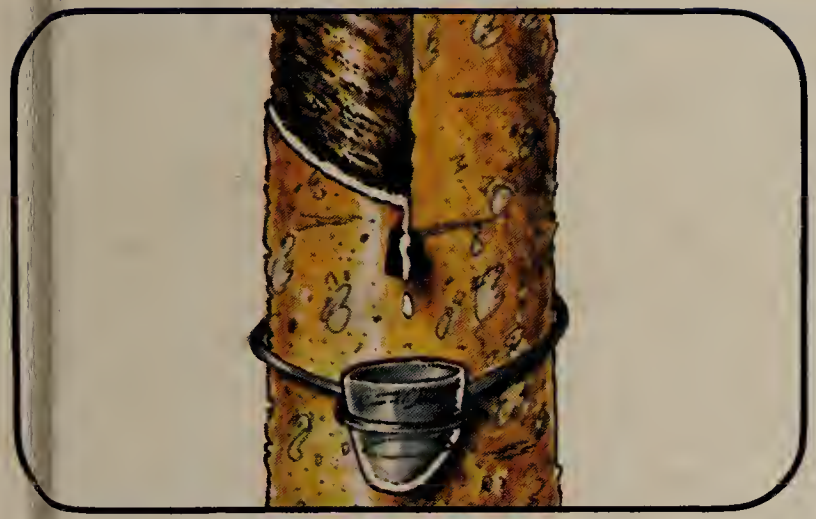
ORIGINS

RUBBER

Tires on your Bike



RICHARD GIBBS

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Origins Books

A Spoonful of Sugar
Rubber Tires on Your Bike
A Loaf of Bread
A Cup of Coffee

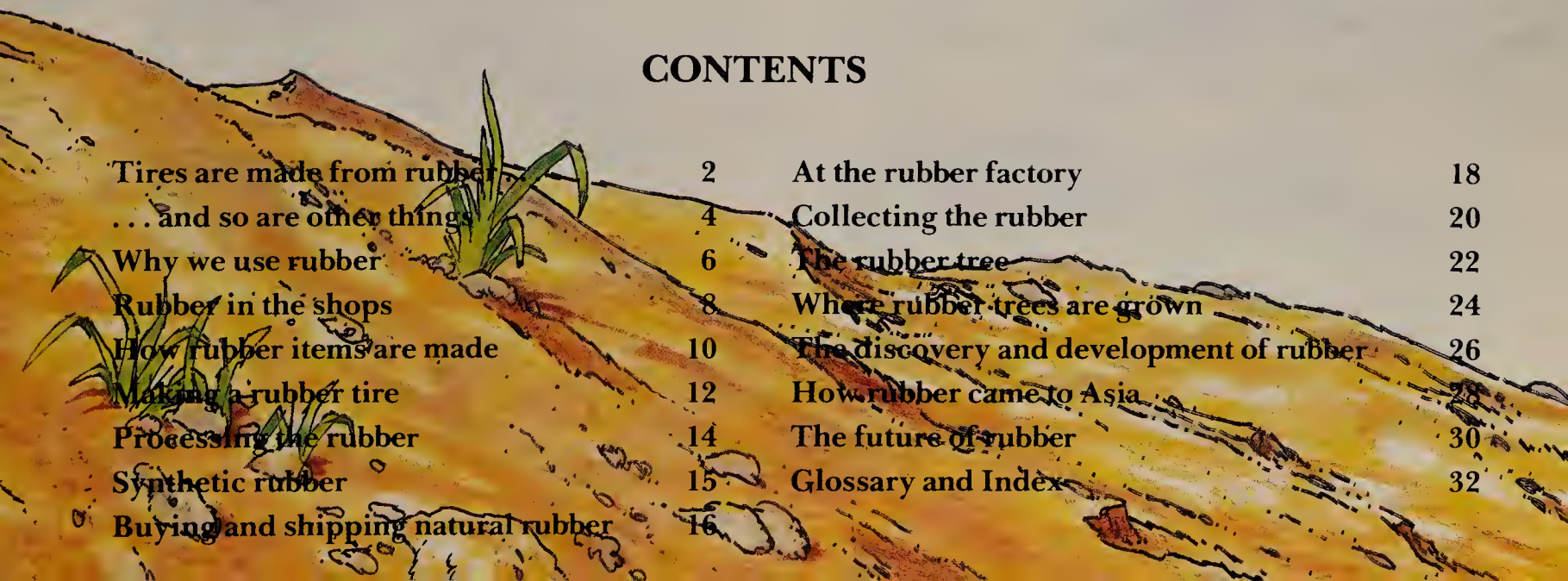
RUBBER

Tires on your Bike

RICHARD GIBBS

An Origins Book

The Bookwright Press
New York · 1983



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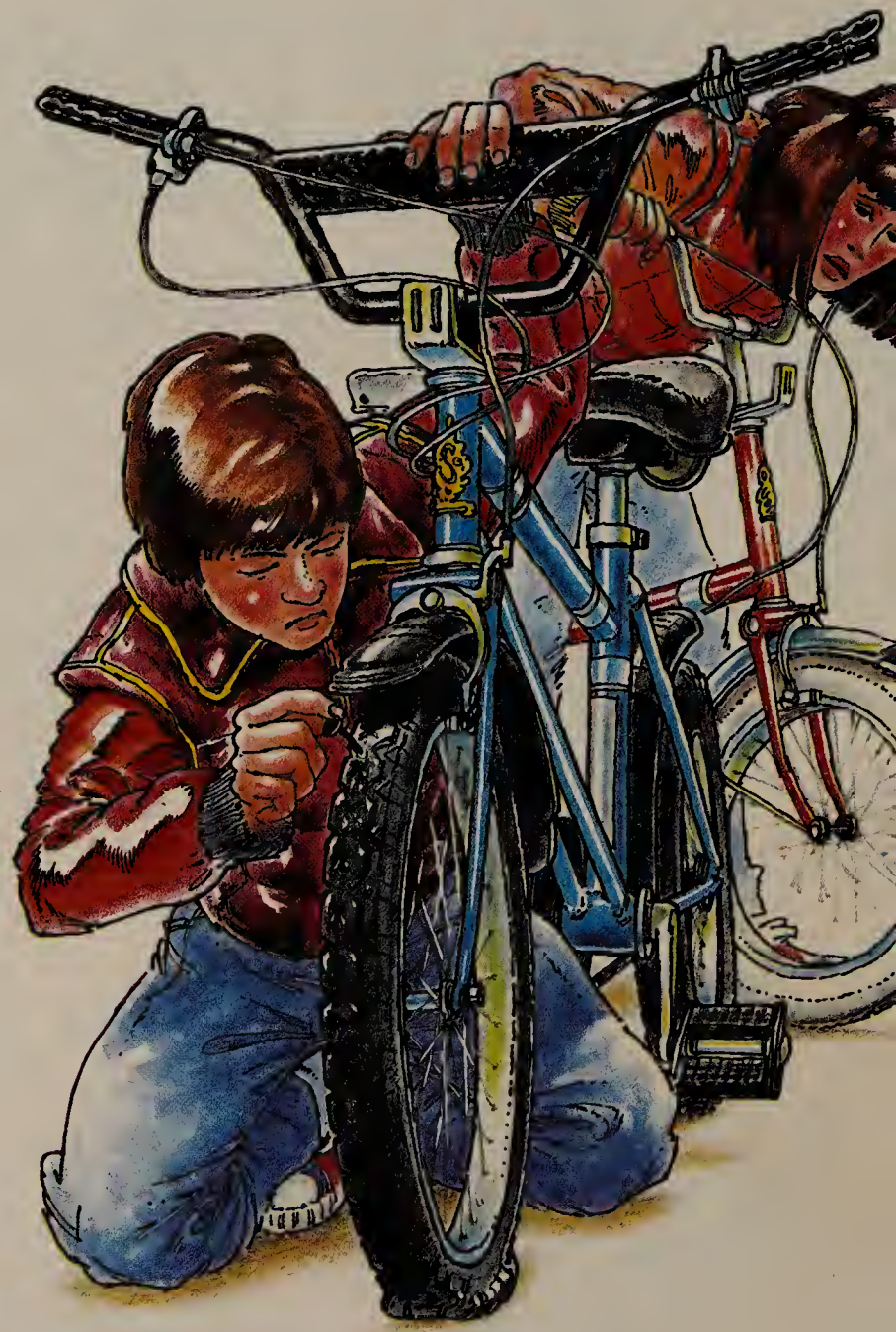
Tires are made from rubber . . .

One morning, Jenny and her twin brother, Peter, decided to bike over and visit their grandfather. Their new bikes were splendid. They had 3-speed gears, thick tires and comfortable seats.

Not far from their grandfather's house, Peter noticed that his front wheel felt strange. He got off his bicycle and felt the tire. It had lost a lot of air. Then he noticed the head of a nail sticking out of the tire – his new bike had a puncture already!

The puncture made Peter think about tires and what they were made of. He asked Jenny, but she didn't know. They would ask their grandfather. Peter pushed his bike the rest of the way while Jenny rode slowly beside him.



Luckily, their grandfather had a puncture repair kit and offered to help Peter repair the puncture after lunch. The twins asked their grandfather if he knew what tires were made of. He told them that they were made from a material called rubber. He explained that rubber is a very versatile material, and it has many uses. Their bicycle seats were filled with it and it was also used for the brake blocks. They repaired the punctured tire after lunch.

Peter and Jenny wanted to know about other things that were made from rubber. Their grandfather thought for a moment – "Boots," he replied, "and lots of other things like hoses, pencil erasers and tennis balls." The twins decided to find out more about rubber when they got back home.

. . . and so are other things

When they got home, Peter and Jenny played a game. They tried to find as many rubber items as they could around the house. Jenny found rubber gloves for washing the dishes in the kitchen, and a rubber plug in the sink. She also found rubber hot-water bottles, which were used to warm up their beds on cold nights.

Peter discovered that the flippers and goggles he used at the beach were made from rubber, and so was the family's inflatable boat. The twins asked their mother if she knew of any other things around the house that were made from rubber. "Look at the sofa and the armchairs," she said. "The cushions are filled with rubber, and some of the mattresses on your beds are rubber." She told them that the backing for the carpets was rubber too, and also the soles of their shoes.

When the twins' father got home from work, they asked him about rubber. He told them that lots of the parts of his car were made of rubber. He lifted up the hood and pointed to the hoses and fan belt in the car's engine. "Those are made of rubber," he said. Then he showed the children the rubber used in other parts of the car. The covers for the clutch, brake and accelerator pedals were rubber and so were the windshield wiper blades and the floor mats.

Jenny and Peter were surprised when their father told them that foam rubber had been pumped into the space between the walls of their home to keep it warm and damp-proof. And their mother pointed out that the elastic in lots of their clothes was made from rubber too. The twins saw that there were hundreds of uses for rubber.

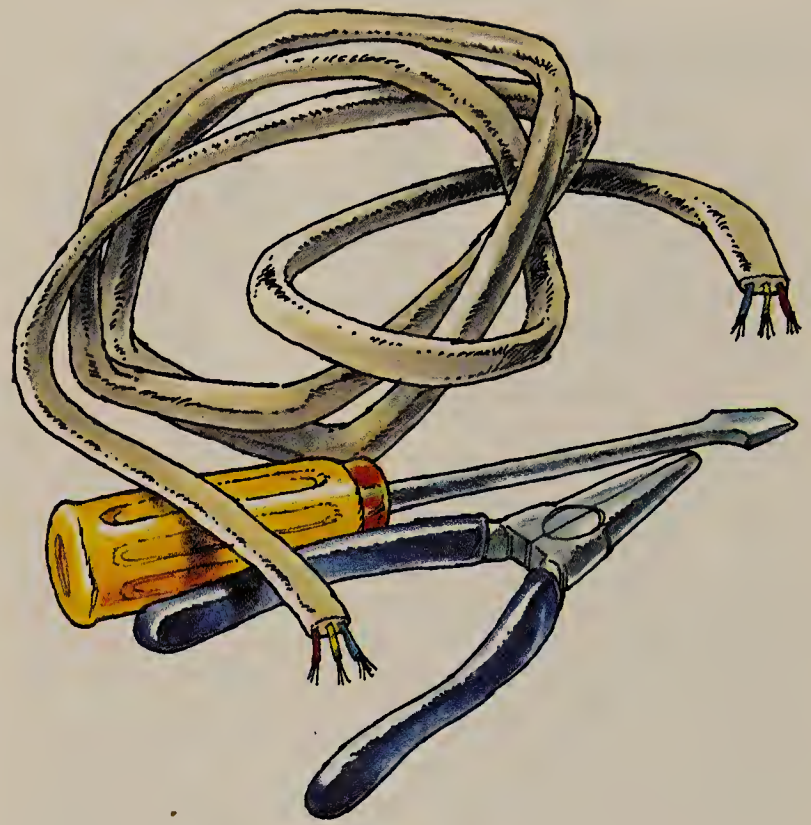
Why we use rubber

Jenny and Peter discovered that rubber is very useful. Hundreds of different products at home, in industry and for transportation, are made from rubber. It is one of the most valuable resources in our modern world. Why is it such a special material?

First, rubber is **elastic.** It can be stretched and it returns to its original shape. No other material is so stretchy. This is why rubber is used for balls, as a filling material for mattresses and furniture, and to hold up our underclothes.

Rubber is also **waterproof.** So it can be used for hoses, hot-water bottles, raincoats bathing caps and waterproof boots.

Rubber is very **tough** and resistant to sharp objects, and it takes a long time to wear out. This is why it is the best material for all kinds of tires.



Most electric wires are covered with rubber. Electricians always wear rubber-soled shoes, and the handles of their tools are usually covered with rubber. The reason that rubber is used so much in connection with electricity is that it is a very good **insulator.** This means that rubber helps to protect people from electric shocks.

Rubber in the shops

Jenny and Peter decided to look around their town and see where products made from rubber can be bought.

The twins found that garages sell tires, innertubes, windshield wiper blades, floor mats, and engine parts made from rubber. Hardware stores sell rubber plugs for baths and sinks, and they also stock hoses, faucet washers, glue, protective gloves, weather stripping and mallets.

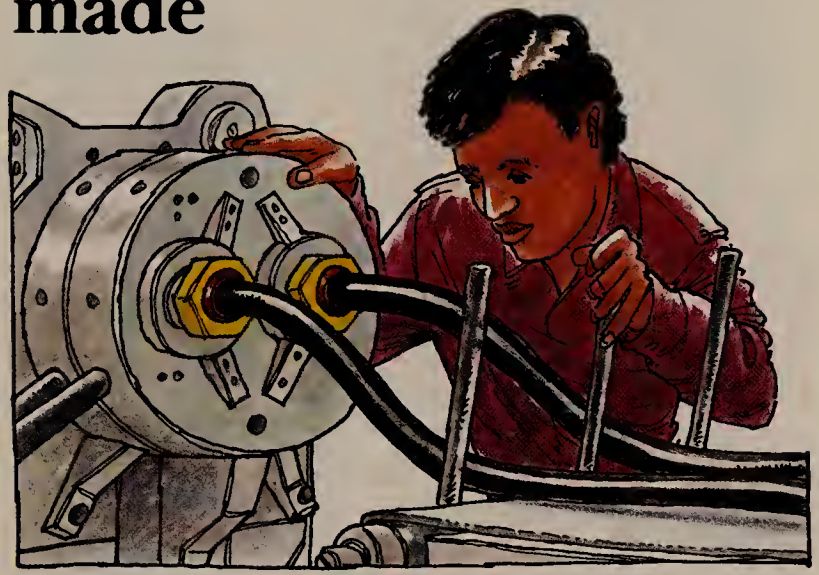
When Peter and Jenny went into their favorite toy store they found that it sold rubber balls, balloons, dolls and flexible toys. And the sports shop nearby stocked many rubber items, including wet suits for skin divers, inflatable boats and different kinds of rubber-soled sports shoes.

The children found that furniture stores, too, sell articles made from rubber. Chairs, mattresses, pillows and cushions are often filled with foam rubber. There were rubber flooring tiles and some of the carpets were backed with rubber. Even the refrigerators and washing machines had gaskets made from rubber.

When they visited a clothing store, Peter and Jenny found waterproof raincoats and ponchos that were made from rubberized material. In the shoe store they found waterproof boots, and shoes with rubber soles. Finally they went into a stationery store and found that there they could buy rubber bands, rubber erasers and flexible rubber rulers for drawing curved lines!

After they returned home, Peter and Jenny thought about all the rubber items they had seen in the stores, and wondered how they were made.

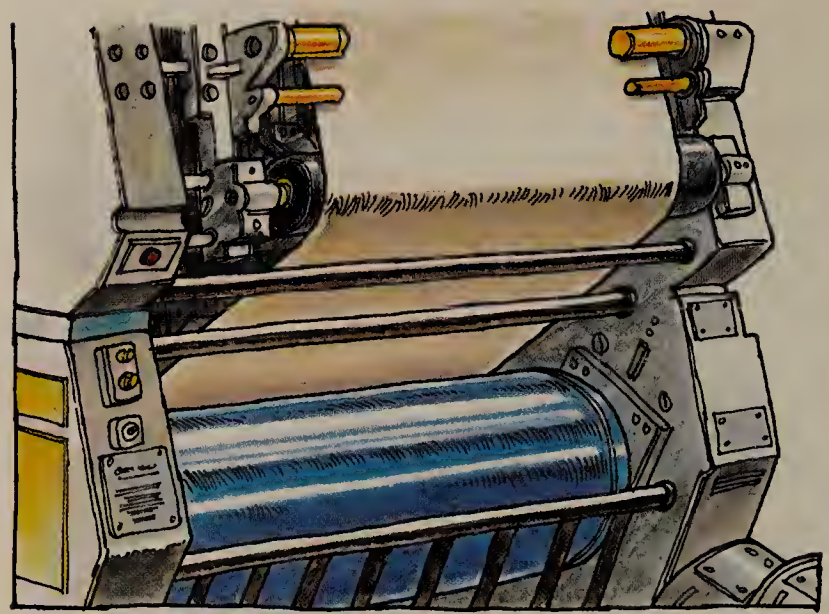
How rubber items are made



Rubber articles that we buy for our homes or that are used in transport and industry are made by different methods.

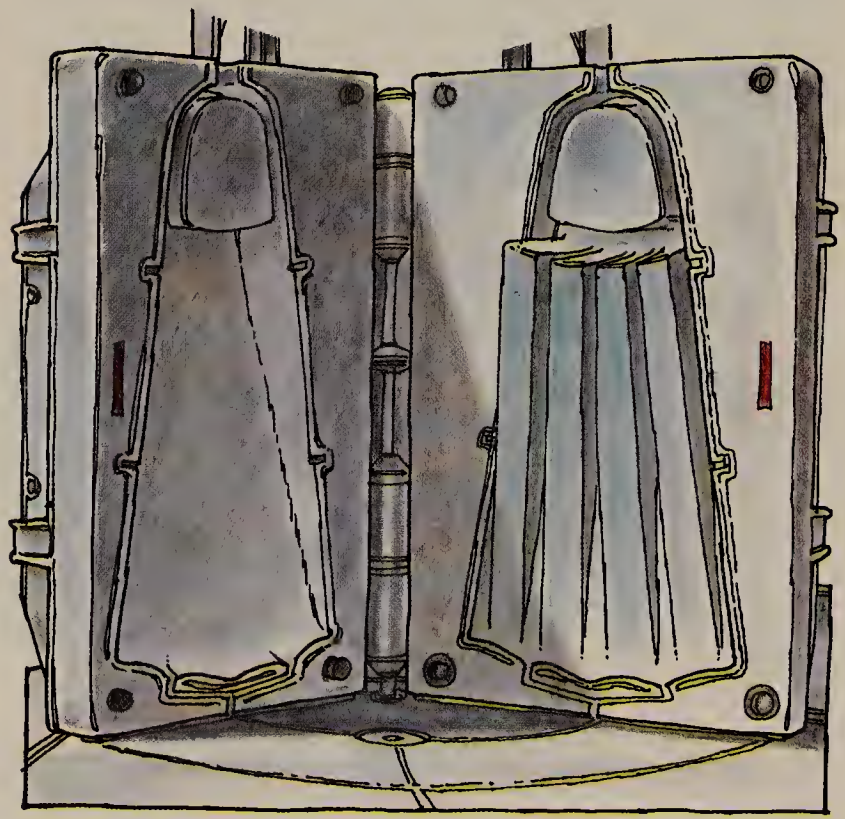
Rubber objects, such as hoses and the outer casing for electric wires, are formed by forcing rubber through a hole. The hole is the same size and shape as the cross-section of the finished product.

Sheet rubber is made by a different process. The rubber is fed into a machine called a calender. Big rollers squeeze and flatten the rubber and it comes out as a smooth sheet. To make waterproofed fabric, a different material, such as woven cotton or nylon is fed into the calender and pressed onto the rubber sheet. Products made from sheet rubber include raincoats, car mats, and inflatable rubber dinghies, weather balloons, air mattresses and bladders for footballs and soccer balls.



Rubber gloves, balloons and hot-water bottles are made with liquid rubber called latex. A shape or mold of the finished article is dipped into the latex and then dried. The latex article is removed from the mold when it is dry. This process is called dipping.

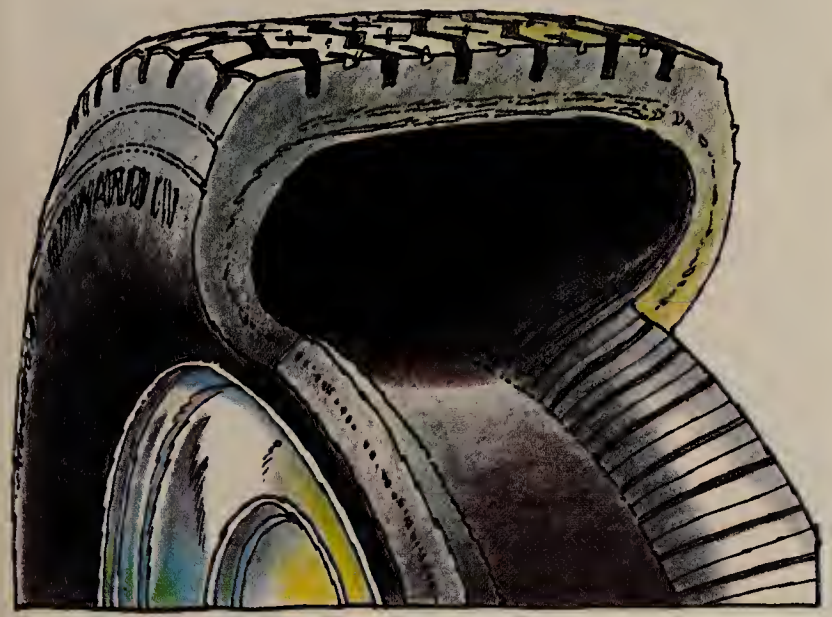
Solid rubber products, like flippers, bath plugs and rubber washers, are made by pouring the rubber into a mold that is the same shape as the article required. Heat and pressure are then applied to the mold.

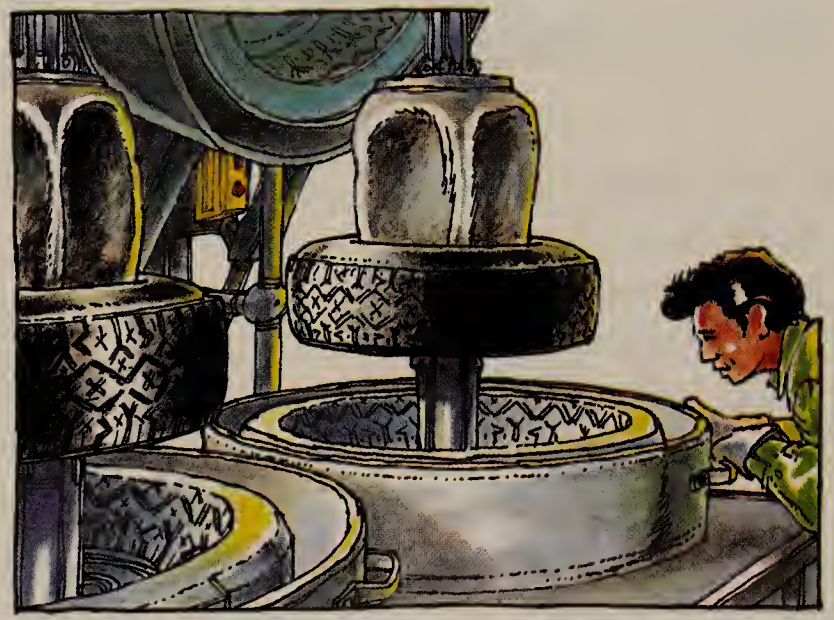


Making a rubber tire

There are hundreds of different types of tires made from rubber: tires for bicycles, for cars, for tractors, for aircraft, and giant tires for earthmoving machinery. More than 60 percent of the world's rubber is used for making tires. Tire manufacturers are huge businesses, employing thousands of people.

Tires consist of three parts: the carcass, which is the main body of the tire; the sidewalls, which protect the carcass from rubbing against curbs and walls; and the tread, which is the part of the tire that comes into contact with the road. Tires are made from rubber, reinforced with strong material. Tires on cars, aircraft, and other heavy vehicles, use rubber that has been reinforced with steel cords. The rubber on bicycle tires is strengthened with a tough material such as nylon or rayon.



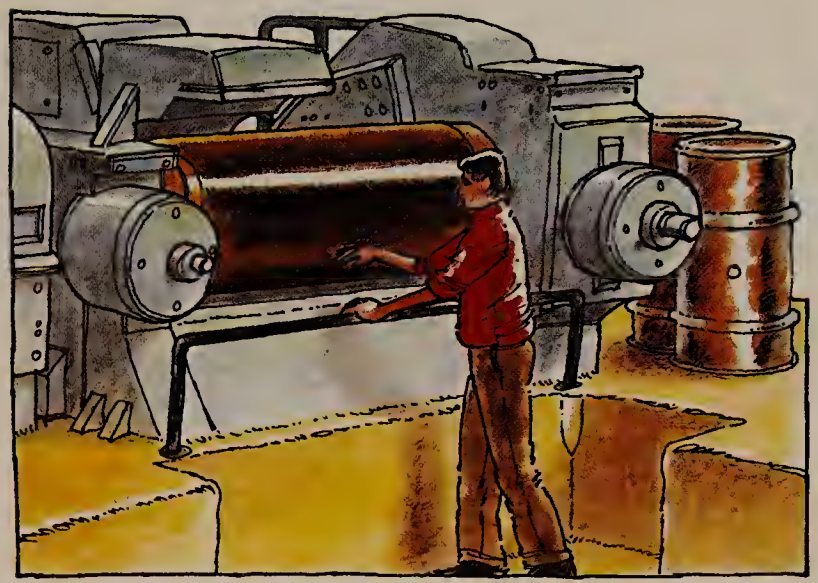


Each tire is built individually by hand. The tire builder brings the carcass, tread, and sidewalls together on a special machine. This is a job that requires great skill and accuracy. The tire is then placed in a mold. Heat and pressure are applied to the mold and it is this process that gives the tire its final shape and strength.

Now the tires are ready to be transported all over the world.

Processing the rubber

Lots of different things happen to rubber before it is made into products such as tires, hoses or waterproof boots. When the rubber arrives at the manufacturer, it is hard, so it first has to be made soft and easy to work with. The rubber is put into a special mixing mill, a machine which is somewhat like a giant food mixer. The mixer breaks up the rubber and makes it soft and pliable.



Substances called fillers are often added to the rubber when it is soft, to make it go further. A fine black powder called carbon black makes the rubber stronger and harder. It is used for car tires, which need to be very strong. Rubber is strengthened when heated with a chemical called sulfur, in a process called vulcanizing.

Some rubber is sold as a liquid. This is called latex. It is used for making items such as hot-water bottles and surgical gloves, and for foam rubber. To make foam rubber, the latex is beaten up like cake batter in a food mixer. The latex is then poured into a mold and left to set. The air bubbles that are beaten into the latex give foam rubber its soft, springy feel.

Synthetic rubber

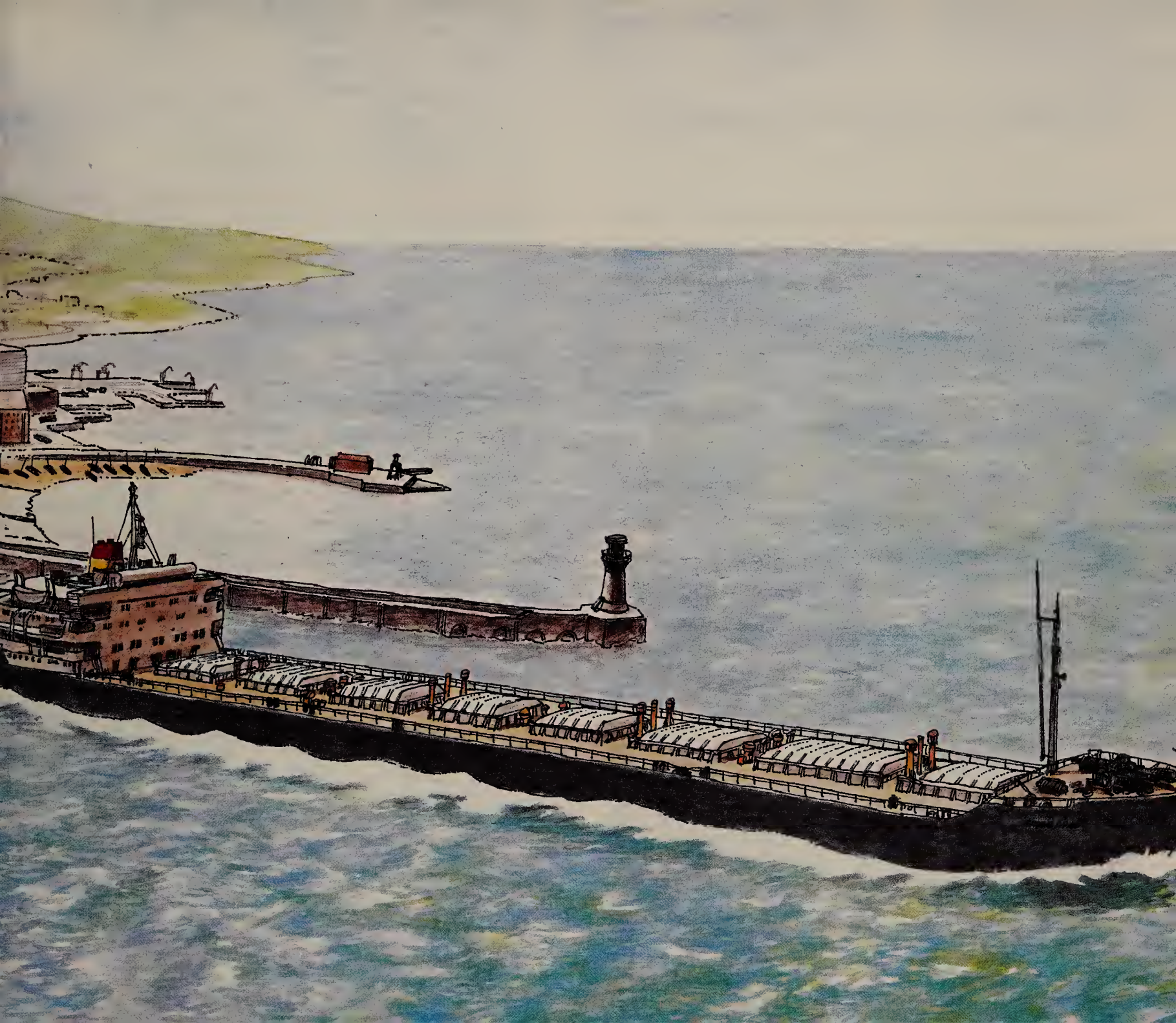
Manufacturers of rubber products use both natural and synthetic (man-made) rubber. Synthetic rubber is made from chemicals that are by-products of oil refining. Many oil-refining companies are also rubber manufacturers. Most of the synthetic rubber they produce is combined with natural rubber in making tires.

Buying and shipping natural rubber

Most natural rubber is produced in Southeast Asia. Singapore and Kuala Lumpur, which is the capital city of Malaysia, are the world's largest trading centers for natural rubber.

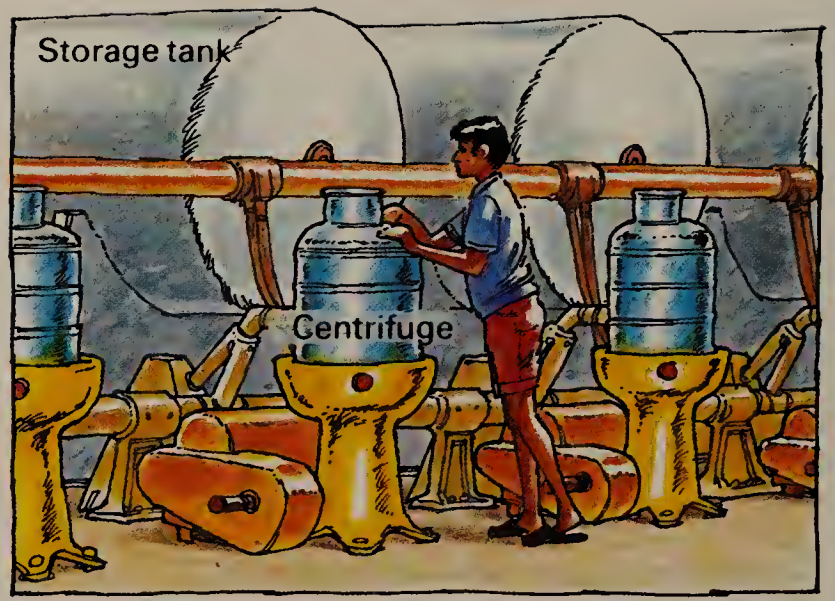
This rubber is obtained from rubber trees, which are grown on plantations or estates. Some of the rubber is carried in liquid form, in large tankers by road or rail, from the rubber estates to the ports. There it is transferred to tanker ships. Other rubber is processed so that it becomes solid, and is then packed into bales, which are transported to the ports.

Bulk-carrier ships transport the natural rubber in liquid and solid form to manufacturers of rubber products all over the world.



At the rubber factory

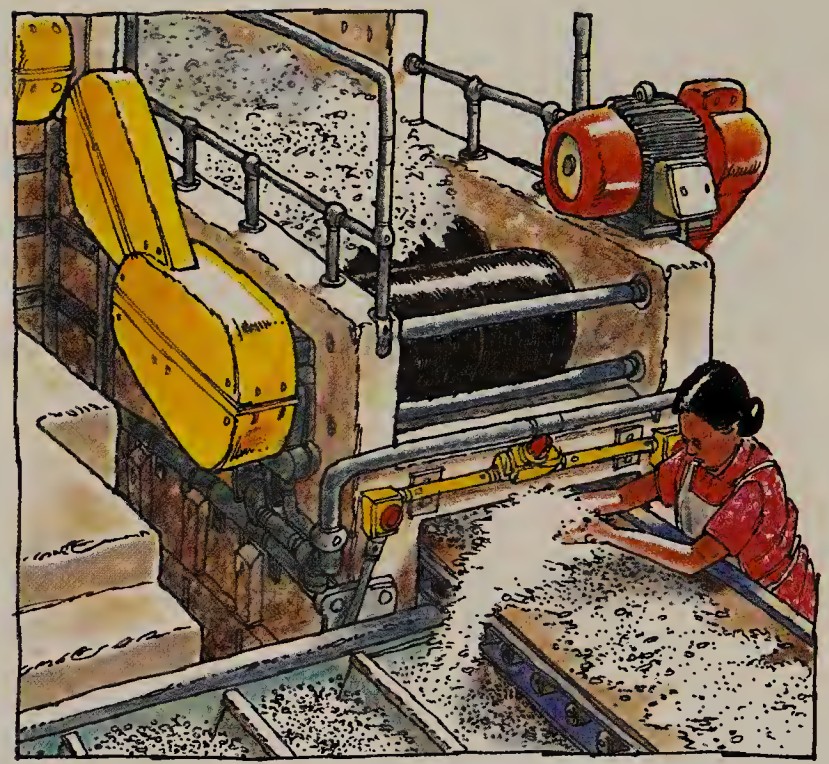
The raw rubber, called latex, flows from the rubber trees in a liquid consisting of one-third rubber and two-thirds water. The latex is processed into concentrated latex, or into dry rubber, in factories on the estate.



To make liquid concentrated latex, the water is separated out of the rubber by spinning it in a machine called a centrifuge. A chemical is then added to the latex to prevent it from turning into dry rubber. The liquid concentrated latex is stored in tanks on the estate, ready to be transported to the ports in road or rail tankers. About one-tenth of all natural rubber is sold as concentrated latex. It is used for making foam rubber, elastic thread, surgical gloves and hot-water bottles.

Most rubber is sold as dry rubber. To make dry rubber, the latex is poured into tanks called coagulators. Acids and salts are added. They make the latex coagulate. This process is rather like the curdling of milk. The latex particles join up to form a spongy mass. Metal plates divide it, and it quickly turns into sheets of dry rubber, called coagulum.

The coagulum is taken out of the tanks and passed through a special machine which chops and minces it into small crumbs. The rubber crumbs are then washed and dried. The dry rubber is now ready to be compressed into bales. It is wrapped in polyethylene, a flexible plastic, to keep it clean. The bales are then packed into large wooden crates and taken to the ports.



Collecting the rubber

The name of the rubber tree is hevea. Hevea trees are grown mainly on large estates, which employ hundreds of workers.

Collecting the liquid rubber from rubber trees is a highly skilled job. It is known as tapping. The rubber tappers begin tapping the trees at dawn because the latex flows best in the early morning. Tappers use a special curved knife to cut a narrow slice of bark, downward at an angle. The latex oozes out into a cup placed below the cut in the bark. Experienced tappers can tap up to five hundred trees by mid-morning. They then return to each tree to collect the latex.

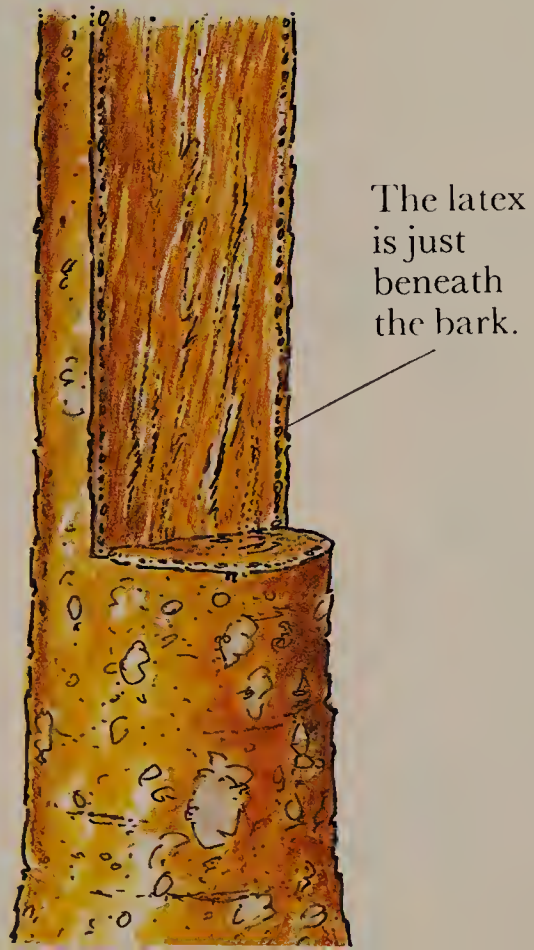
Large rubber estates provide housing for their workers, and some have schools, hospitals, stores and sports facilities, all on the estate.

Most rubber estates have their own factories, so the latex is turned into dry rubber and latex concentrate before it is taken away from the estate.
The manager of a large rubber estate has a busy job.

The manager buys the equipment, fertilizers and other supplies for the estate and its factory. Managers and their assistants also have to plan the planting of new rubber trees. This is necessary to replace old, low-yielding or dead trees.

The rubber tree

Rubber trees are among the most useful trees in the world. In their natural state they can grow up to 130 feet (40 m) high and live a hundred years. But trees from which latex is tapped rarely grow higher than 65 feet (20 m) and only live about thirty years.



The latex is a milky liquid. It flows from a layer of tiny tubes that spiral up the rubber tree just underneath the outer bark. The milky latex oozes slowly out of the cut made by the tapper, and flows into the cup, which has been placed below. The flow of latex stops after two or three hours, and the cup containing the precious liquid is ready to be collected.

The next time the tree is tapped, the new cut is made just below the earlier one, and so on all the way down the trunk. When a whole section of the tree has been tapped, it is left to heal completely. The tappers continue to take rubber from a different part of the tree while it is healing, and they only retap the earlier section when it is completely healed.

Young rubber seedlings are grown in pots in a greenhouse. When they are a year old they are planted out in rows. Other crops, such as peas and beans, are planted between the young rubber seedlings, to hold the soil around them and to shade them from the sun. These crops also help keep the soil around the seedlings moist, and make it more fertile, so that the growing rubber trees will be healthy and strong. By the time they are six years old, the trees will be ready for their first tapping.

Where rubber trees are grown

Most rubber trees are grown in Southeast Asia. Malaysia, Indonesia and Sri Lanka are all important rubber-producing countries. A much smaller amount of natural rubber comes from trees grown in West and Central Africa. Very little rubber now comes from South America, although it was in the jungles of the Amazon River that the first rubber trees were found.

Rubber trees grow best where it is very hot and where there is a lot of rain. So rubber trees are found in jungle areas close to the equator. Large areas of jungle in Southeast Asia and Africa have been cleared so that rubber trees can be specially grown.

There are many rubber plantations in Malaysia, which is the world's largest producer of rubber. Many Malaysians earn their living directly from rubber, and the export of natural rubber is essential to the country's trade.

After 1950 the Malaysians began to modernize their methods of producing rubber. This was because synthetic rubber from oil-refining companies was beginning to compete with natural rubber. The old rubber trees on the estates were replaced with trees that produced more rubber. The Malaysians also researched new ways of preparing and processing rubber.

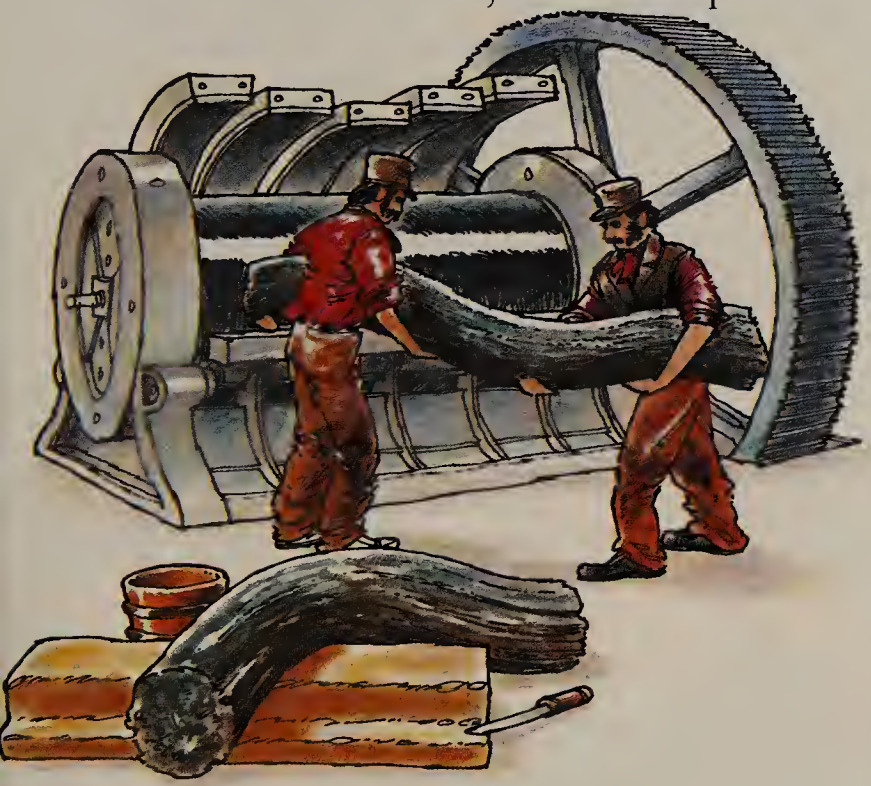
The discovery and development of rubber

Rubber has been used for centuries by the South American Indians. Many years before anyone knew about it in Europe, the Indians collected latex from the rubber trees of their native jungles and made simple articles in molds, or dipped shapes into the rubber and allowed them to set.

The first European to learn about rubber was Christopher Columbus, the famous explorer. In 1496, he returned from his second voyage to the New World with many strange tales. One was that the natives of the island of Haiti played with a ball made from the gum of a tree. The ball actually bounced!

European explorers brought some of this magical stuff back with them. But, by the time it arrived in Europe, the rubber was hard and difficult to use, so it was thought to be of little use. It came to be known as rubber when a British chemist, Joseph Priestley, discovered that it would rub out pencil marks!

In 1820 an Englishman, Thomas Hancock, invented a machine he called a masticator (a mixing mill). This machine shredded the rubber and made it soft, warm and pliable.



Many people then began to use rubber. One of its earliest uses was for the mackintosh (a rubberized raincoat) – the first really waterproof garment. But there were problems. Rubber became sticky in hot weather and brittle in cold weather.

The cure for this was found in 1839. An American named Charles Goodyear heated raw rubber with a chemical called sulfur. When the rubber cooled, he found that it was much stronger and more resistant to heat and cold. This process became known as **vulcanization.** It was discovered that if rubber was vulcanized in a mold, the rubber article would stay in that shape when it cooled. This was a very important discovery. It opened the way for the manufacture of hundreds of different rubber goods.

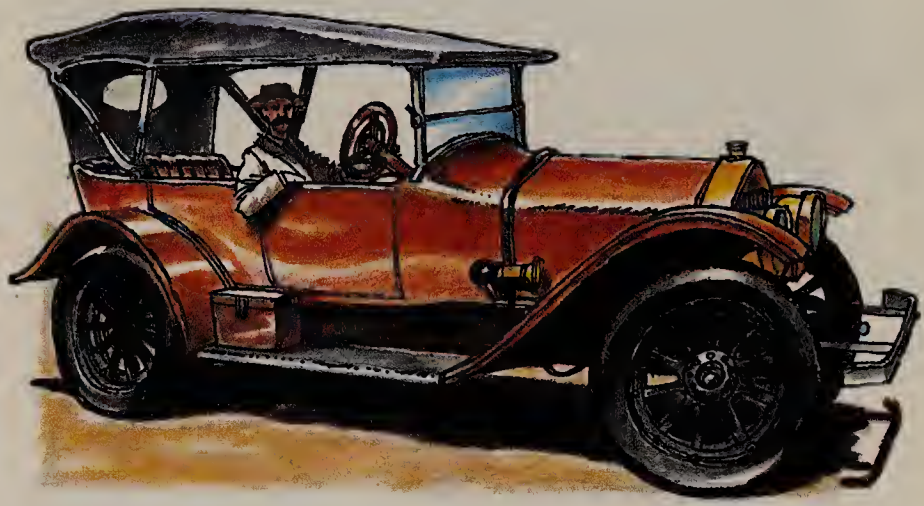
How rubber came to Asia

The demand for rubber grew as people learned how to make different products from it. But it soon became necessary to find a more easily accessible area in which to grow rubber trees. It was very difficult to collect rubber in the dense jungles of South America.

Botanists in Britain thought it would be possible to grow rubber trees in Asia. In 1876, an expedition was sent to Brazil to collect rubber tree seeds. These were brought back and placed in specially prepared hothouses at the Royal Botanic Gardens at Kew in London. Most of the seedlings were sent to Ceylon – later named Sri Lanka – and to other countries in Southeast Asia.

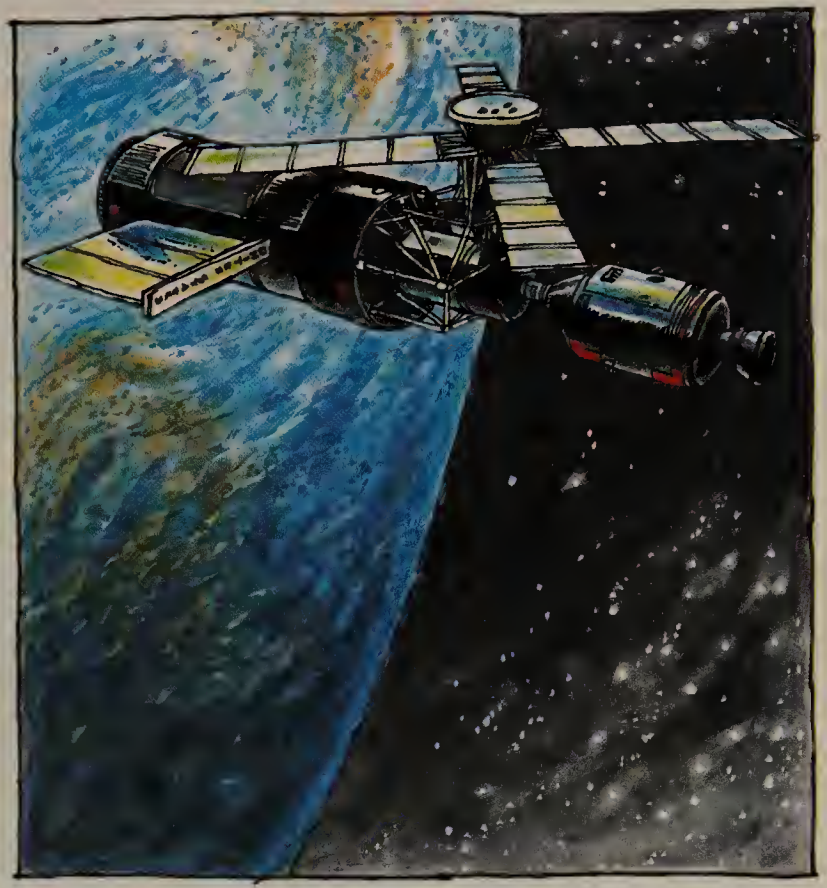
Ways of making rubber production more efficient were discovered during the following years. It was found that shaving off a thin piece of the rubber tree's bark produced more latex than did slashing into it, which had been the method used until then. This also caused less damage to the tree. Better ways of changing the liquid latex into dry rubber were also discovered.

At the beginning of this century cars began to be produced in large numbers. Rubber was soon in great demand by the car manufacturers, for making tires for the cars. Large areas of jungle in Southeast Asia were cleared and turned into rubber plantations, to satisfy the steadily increasing demand for rubber.



Then scientists discovered that it was possible to make rubber from by-products of oil refining. Although the first synthetic rubbers were not very good, in time the quality of these man-made rubbers improved.

The future of rubber



Rubber is a unique substance. Its amazing properties have made it one of the most useful and versatile materials known to man. Scientists, engineers and technicians are constantly thinking of different ways of using rubber.

They have developed special kinds of rubber that surgeons can use to repair our bodies. Some rubber has been developed that can even withstand the extreme conditions of outer space and the icy depths of the oceans.

There will come a time when it will no longer be possible to produce synthetic rubber. This is because it is made from oil, and the world's oil supplies will eventually run out. It is very important, therefore, to make good use of natural rubber.

Scientists have found ways of breeding trees that produce more latex. They are also breeding trees that are stronger and more disease-resistant, and that can be tapped at a younger age.

Rubber is a wonderful, versatile material, and it plays a vital role in our world. Imagine a world without tires or bouncing balls! It is certain that many more uses for rubber will be discovered in the years to come.

Glossary

CALENDER A series of huge rollers used to press rubber into sheets.
CARBON BLACK A substance added to rubber to make it stronger and harder.
CENTRIFUGE A device that separates substances by spinning rapidly. Sometimes called a separator.
COAGULATOR A tank in which liquid latex is made to form a solid mass.
COAGULUM A mass of dry rubber.
DIPPING The process of shaping rubber by dipping a shape or mold into the liquid latex.
EXTRUSION The process of shaping rubber by squeezing it through a metal tube.
FILLER Material added to soft rubber to increase its volume.
LATEX The milky liquid that flows from the rubber tree; also (in manufacture) liquid rubber.
MIXING MILL A machine that shreds and softens dry rubber; sometimes called a masticator.
TAPPING; TAPPERS The process of collecting liquid rubber from rubber trees by cutting the bark; workers who carry out this process.
VULCANIZATION The process of heating a mixture of rubber and sulfur to make rubber that stays tough and firm in heat or cold.

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ORIGINS

If you look around your home, and watch the roads on your way to school, you will see just how much use is made of rubber. Do you know why it is such an important material, especially for tires? This book tells the story of rubber, beginning with a bicycle tire and following its route back to the rubber tree on the plantation. It also describes the development and importance of rubber.

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